ELECTRICAL AND CHEMICAL PROPERTIES OF THERMALLY AGED
VEGETABLE-BASED OILS AS HIGH VOLTAGE INSULATING MATERIAL

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Dedicated to my beloved family for their encouragement and support
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ABSTRACT

Researches on the viability of using vegetable-based or plant-based oils in power transformers are gaining much attention due to their excellent biodegradability and good dielectric properties. Several vegetable-based oils have been studied and found to have potentials to be used as transformer insulating oil. However, studies on their long-term ageing properties and improvement on their dielectric properties are still lacking. This thesis reports laboratory studies carried out on eight different vegetable oils and their blends to investigate their dielectric properties when subjected to accelerate thermal ageing. The vegetable oils are canola oil, coconut oil, olive oil, palm olein oil, sesame oil, CO25 oil (75% canola 25% olive), CO50 oil (50% canola 50% olive) and CO75 oil (25% canola 75% olive). The samples were thermally aged at 150°C for 520 hours and their dielectric properties were investigated. The dielectric properties were fire point, pour point, dielectric dissipation factor (tan δ), breakdown voltage, refractive index, kinematic viscosity and Fourier Transform Infrared Spectroscopy (FTIR). Mineral oil was also investigated in the same fashion for comparison purposes. Results from this study show that in overall, mineral oil was the least aged and most stable oil sample after undergoing accelerated thermal ageing. Vegetable oil samples experienced higher degree of ageing and oxidation. However, the vegetable oil samples showed higher breakdown voltage. Among these vegetable oil samples, coconut and sesame oil samples were the most aged and have the lowest breakdown voltage, while olive was the least aged and the most stable. In terms of oxidation stability, sesame and canola experienced the highest oxidation while olive and coconut experienced the least. Furthermore, in this study the blending of the canola and olive oils improves their dielectric properties and oxidation by as much as 37%. The finding in this study thus suggests that vegetable-based oils can have good long-term dielectric properties as insulating oils for high voltage applications. In addition, blending of vegetable oils can also improve their insulating properties and oxidation stability.
ABSTRAK